4 AFFECTED ENVIRONMENT

The APS is located in the southwestern quadrant of ANL-E (Figure 3.1), which is located in DuPage County, Illinois, 27 mi (43 km) southwest of downtown Chicago (Figure 1.1).

4.1 SITE DESCRIPTION

The terrain of ANL-E is gently rolling, partial wooded, former prairie and farmland. The site is divided into a number of campus-like areas that contain the various research and development facilities of this multipurpose laboratory.

4.2 GEOLOGY AND SOILS

The geology of the ANL-E area consists of about 100 ft (30 m) of glacial drift on nearly horizontal bedrock consisting of Niagran and Alexandrian dolomite approximately 200 ft (60 m) thick with an irregular eroded upper surface. The upland soils of the site were derived from glacial till and are primarily well drained, with low organic content and a large water capacity. Along the intermittent streams and upland depressions, soils are poorly drained, with high organic matter content and a large water capacity.

No tectonic features within 62 mi (135 km) are known to be seismically active. The few recent minor earthquakes that have occurred in northern Illinois are presumed to have been caused by isostatic adjustments of the earth's crust in response to glacial loading and unloading. The nearest areas of seismic activity are located in the St. Louis area (New Madrid fault zone) and along the southern Illinois-Indiana border (Wabash Valley Fault zone), each located about 200 mi (322 km) from ANL-E. Ground motions for the ANL-E site are expected to be minimal. Peak accelerations of 10% of gravity (the approximate threshold of major damage) may occur once in approximately 600 years (-250 to +450 error range) (Golchert et al. 2001).

Soil activation from APS operation is negligible (Moe 1991), because the main activation component of the radiation proceeds in the forward direction relative to the beam; therefore, it is completely absorbed by the collimators and beam stops. The scattered photons are incapable of activating soil. Potential soil contamination by deposited airborne radionuclides would be negligible, too, because of the small amount of air emission rates (less than 7.4 Ci in year 2001 [Golchert and Kolzow 2002], see Section 4.9.1 for more discussion) and the fact that the radionuclides released (C-11, N-13, and O-15) are short-lived, with half-lives less than 20 minutes. Even if airborne radionuclides would have a chance to deposit to surface soil, they would decay away shortly after deposition.

4.3 WATER RESOURCES

4.3.1 Surface Water

The ANL-E site lies above the bluffs bordering the Des Plaines River valley, which was formed by glacial meltwater draining the area that is now Lake Michigan about 11,000 to 14,000 years ago. This valley contains the Des Plaines River, the Chicago Sanitary and Ship Canal, and the Illinois and Michigan Canal. The ANL-E site is drained by Sawmill Creek (average flow of approximately 7.5 million gal/day [28 million L/day]). A number of unnamed intermittent tributaries of Sawmill Creek drain the area surrounding the northern portion of the APS site. These tributaries arise from wetlands located west and north of the APS site. The southern portion of the APS site drains south to the Des Plaines River. Surface water drainage patterns of the APS site and surrounding areas are shown in Figure 4.1.

The APS facility does not include sanitary or laboratory wastewater treatment facilities; sanitary and laboratory wastewaters are separately collected, treated, and discharged by the ANL-E sanitary wastewater treatment plant and the ANL-E laboratory wastewater treatment plant. Therefore, at the APS site, only stormwater discharges have the potential to affect surface water.

Operation of the APS facility as currently configured includes control of stormwater. Stormwater flow from the APS site is illustrated in Figure 4.1. For the purposes of discussion, these drainages have been grouped into (1) drainage from the northern portion of the APS into Wetland 302, (2) drainage from the eastern portion of the APS, (3) drainage into Wetland R, (4) drainage to the south, and (5) drainage from the northwestern portion of the APS into Wetland 302.

Stormwater from the northern portion of the APS site, including parking lots near the main building, flows west into a drainage channel that empties into the downstream end of Wetland 302. This drainage system carries runoff from grassy areas and parking lots, as well as wooded areas beyond the APS site. Water in this channel is retarded by natural vegetation and by a small riprap dam. This retardation allows some infiltration of water and assists with settling of particulates and degradation and removal of organic material. However, this end of Wetland 302 is somewhat degraded.

Stormwater from the eastern portion of the APS is routed to a vegetated channel that discharges through NPDES Outfall 115 at the site boundary southeast of the APS site. This drainage flows toward the Des Plaines River through the Waterfall Glen Forest Preserve. The Outfall 115 system drains the APS facility and associated roadways and loading docks. This discharge also includes drainage from areas beyond the APS site, including Buildings 314, 315, and 316 complex storage areas, loading docks, and cooling water discharges. In 2000, toxicity tests showed that discharges from Outfall 115 were acutely toxic to the water flea but not to the fathead minnow during the months of July and August. This toxicity was associated with chlorinated cooling water discharges and other drainage from Buildings 314 through 316; these

FIGURE 4.1 Surface Drainage Patterns for the APS Site (arrows indicate direction of flow)

discharges were rerouted during 2000 and 2001 to the ANL-E laboratory wastewater treatment plant (Golchert et al. 2001). Stormwater from the eastern portion of the APS site drainage would not impact the water quality of receiving waters.

Stormwater from the southern portion of the APS site drains to the south. Water accumulated in the area encompassed by the eastern half of the storage ring is collected and routed to Wetland R near the southern APS site boundary. Wetland R also receives drainage from roadways and a parking lot outside the storage ring. The quantity of water provided to Wetland R has a high degree of fluctuation, depending on rainfall patterns. Water entering Wetland R may contain some salts and other compounds from roadways and parking areas.

Stormwater from the northwestern portion of the APS site is currently routed to a vegetated collection basin located southeast of the intersection of Kearney and Rock Roads. This basin has minimal storage capacity. The collection basin receives surface runoff from a small parking area and access road, drainage ditches along the east side of Kearney Road and the south side of Rock Road, a parking area near LOM 438, and roof drains from the western portion of the APS ring. The total drainage area of the basin is approximately 614,400 ft^2 (57,000 m^2), about 36% of which consists of impervious surfaces. The vegetated surfaces permit some stormwater to infiltrate to subsurface soils, slow the movement of surface runoff, and potentially filter out some contaminants originating in parking areas. Vegetation within the basin helps to reduce the velocity of surface water flow through the basin, permitting some additional removal of suspended particles and slight reduction of flow peaks. Surface water flows north out of the basin through a culvert under Rock Road and into a small stream that feeds directly into Wetland 302

Short-lived activation products can be produced in the water circulated in a closed system to cool the accelerator component of the APS. Small amounts of this water may be released to the wastewater treatment system as part of maintenance operations. Oxygen-15 (O-15), the primary activation product in the cooling water, has a very short half-life (2 minutes) and decays before maintenance begins. Measurement data at the wastewater treatment plant outfall do not show the existence of O-15 in the effluent (Golchert et al. 2001).

4.3.2 Groundwater

Two principal aquifers are used as water supplies in the vicinity of ANL-E and are located at depths of approximately 200 ft (60 m) and 500 to 1,500 ft (150 to 450 m) below the surface. In northeastern Illinois, the shallow groundwater is within glacial drift units of varying character and extent, and within the underlying Silurian dolomite (Hughes et al. 1966). At the APS, the depth to dolomite is about 100 ft (Killey and Trask 1994). The glacial drift comprises the Wadsworth formation and the underlying Lemont formation (Killey and Trask 1994), both of which are dominated by silty and clayey, low-permeability materials. However, the drift also contains sand, gravel, and silt units that are capable of transmitting water. Because of complex erosional and depositional processes during glaciation, these units vary in thickness, texture, and lateral extent, and their interconnectedness between boreholes is uncertain. A drilling program at the APS site suggests that the uppermost sand unit is at an elevation of about 720 ft (219 m)

(Killey and Trask 1994), although thin, minor sand units may be locally present in unsampled areas.

The APS facility does not use or discharge to groundwater. Potential contamination of groundwater by infiltration of contaminants in soil is negligible because of negligible soil contamination. Discussions on soil contamination are provided in Section 4.2.

After 1997, ANL-E began to receive Lake Michigan water originating from the City of Chicago municipal water system. ANL-E now receives all its water from this source, as purchased through the DuPage County Water Commission. Surrounding communities obtain drinking water from the Lake Michigan supply and private wells. A few neighboring homeowners still rely on groundwater wells. Nearby residents who use groundwater are north and west of the APS and upgradient of the facility.

4.4 AIR QUALITY AND NOISE

4.4.1 Meteorology

The climate of the area is representative of the upper Mississippi Valley as moderated by Lake Michigan. The meteorology of the ANL-E site is monitored at the on-site ANL-E meteorological station, which is located adjacent to the APS site. Meteorological conditions for 2000 are summarized in the ANL-E 2000 Site Environmental Report (Golchert et al. 2001).

The long-term average wind direction varies from west to south, with a significant northeast component. Average annual historical precipitation for ANL-E is 31.98 in. (79.95 cm). Precipitation is due to rain and thunderstorm activity in the spring and summer and sleet and snow in the winter. Severe weather includes the threat of tornadoes in the spring and summer. ANL-E has been struck by tornadoes in the past; damage was minor. The average monthly historical temperature is 47.49°F (8.6°C), with a high average temperature of 71.06°F (21.7°C) in July and a low average temperature of 27°F (-4.2°C) in January.

4.4.2 Air Quality

Air emissions at the ANL-E site are discussed in the 2000 Site Environmental Report (Golchert et al. 2001). Table 4.1 compares the emissions from ANL-E and the APS with emissions in the nearest three counties. At the end of 2000, a total of 47 individual air pollution control permits were in place, including 26 permits for radionuclide emission sources. As of December 31, 2000, the APS emission sources subject to permit included three emergency generators (for combustion product emissions) and the APS (for radionuclide emissions). On April 3, 2001, ANL-E received a sitewide Title V Operating Permit covering all regulated air pollutants at the facility. The above mentioned sources are covered under this sitewide permit.

TABLE 4.1 Emissions from ANL-E and Nearby Counties[a]

Source[b]	Emissions (tons/yr)					
	SO_2	NO_x	VOCs	CO	PM_{10}	$PM_{2.5}$
Three counties[c]	147,000	148,000	172,000	116,000	83,000	32,100
ANL-E	84.3	116	0.9	45.1	1.33	<1.33
APS total	0.349	2.14	0.069	1.18	0.080	<0.080
APS facility	0	0.028	0	0	0	0
APS emergency generators	0.349	2.12	0.069	1.18	0.080	<0.080

[a] County emissions are for 2001; ANL-E and APS emissions are for 2000.

[b] CO = carbon monoxide; NO_x = nitrogen oxides; PM_{10} = particulate matter with an aerodynamic diameter equal to or less than 10 micrometers; $PM_{2.5}$ = particulate matter with an aerodynamic diameter equal to or less than 2.5 micrometers; SO_2 = sulfur dioxide; VOCs = volatile organic compounds.

[c] ANL-E is in DuPage County near the borders of Cook and Will Counties.

Sources: EPA (2003); Golchert et al. (2001).

ANL-E is in DuPage County, which is within the Metropolitan Chicago Interstate Air Quality Control Region and within the Chicago-Gary-Lake County severe ozone nonattainment area. Table 4.2 compares state ambient quality standards and highest concentrations of criteria pollutants measured near ANL-E in 2001. Illinois ambient standards are the same as the Federal National Ambient Air Quality Standards.

A list of environmental permits issued to ANL-E is provided in Appendix C.

4.4.3 Noise

Sources of noise at ANL-E include car and truck traffic and utilities, such as fans, motors, air conditioners, cooling towers, chillers, and transformers. Interstate 55, the Stevenson Expressway, immediately north of the site, and Lemont Road, to the west, are heavily traveled by high-speed traffic, including trucks.

4.5 LAND USE, RECREATION, AND AESTHETICS

The APS is part of ANL-E, a DOE energy research and development facility. The ANL-E facility is a campus-like setting, with buildings and facilities interspersed with woodlands, grassland, and wetlands that provide mitigation for impacts to other wetlands on the ANL-E site. ANL-E is surrounded by the Waterfall Glen Forest Preserve of the DuPage County Forest

TABLE 4.2 National and Illinois Ambient Air Quality Standards

		Standard		Three-County[b] Maxima in 2001[c]	
Pollutant[a]	Averaging Time	Primary	Secondary	Value	County
PM_{10}	Annual arithmetic mean	50 $\mu g/m^3$	Same as primary	38 $\mu g/m^3$	Cook
	24-hour	150 $\mu g/m^3$	Same as primary	137 $\mu g/m^3$	Cook
$PM_{2.5}$	Annual arithmetic mean	15.0 $\mu g/m^3$	Same as primary	20.8 $\mu g/m^3$	Cook
	24-hour	65 $\mu g/m^3$	Same as primary	62.3 $\mu g/m^3$	Cook
SO_2	Annual arithmetic mean	0.03 ppm	None	0.005 ppm	Cook, Will
	24-hour	0.14 ppm	None	0.045 ppm	Cook
	3-hour	None	0.5 ppm	0.084 ppm	Cook
CO	1-hour	35 ppm	Same as primary	5.5 ppm	Cook
	8-hour	9 ppm	Same as primary	4.7 ppm	Cook
Ozone	1-hour/day	0.12 ppm	Same as primary	0.122 ppm	Cook
	8-hour/day	0.08 ppm	Same as primary	0.103 ppm	Cook
NO_2	Annual arithmetic mean	0.053 ppm	Same as primary	0.032 ppm	Cook
Pb	Quarterly arithmetic mean	1.2 $\mu g/m^3$	Same as primary	1.06 $\mu g/m^3$	Cook

[a] NO_2 = nitrogen dioxide; Pb = lead.

[b] ANL-E is in DuPage County near the borders of Cook and Will Counties.

[c] Tabulated values are maxima and are not always directly comparable with the standards, some of which must be assessed statistically.

Source: IEPA (2002).

Preserve District. This forest preserve contains trails for hiking, biking, horseback riding, cross-country navigation sports, and cross-country skiing. Parking facilities are maintained just north of the main entrance of ANL-E. The Argonne Park is a picnic and recreational area in the eastern portion of the ANL-E site that also contains the Argonne Child Development Center, a day care center for site employees.

The APS is located amid a backdrop of woods, grassland, and wetlands, which provide mitigation for impacts to wetlands on the ANL-E site. The multistory main building of the APS is visible from adjacent facilities at ANL-E but is not visible to most nearby residential developments. The APS is visible from higher elevations in the town of Lemont to the south. Other visible structures include the multistory Argonne Guest House, which is located just north of the APS site. Land adjacent to the APS site to the south is part of the Waterfall Glen Forest Preserve; this area can be accessed by road and contains trails and a model airplane field. APS facilities are visible to hikers and bikers traveling through the area and other day users.

4.6 ECOLOGICAL RESOURCES

4.6.1 Terrestrial Biota

The 1,500-acre (608-ha) ANL-E site includes approximately 850 acres (344 ha) of developed areas (e.g., facilities, roadways, and parking lots) and 650 acres (264 ha) of relatively undisturbed woodlands, old fields, and wetlands. The site is surrounded by the Waterfall Glen Forest Preserve, which contains habitat types similar to the undeveloped habitats present on ANL-E. The 2,240-acre (907-ha) preserve is managed by the Forest Preserve District of DuPage County.

Habitats on the ANL-E site include mature and immature deciduous forest, coniferous forest, open woodland, old field, prairie, wetland (marsh and forested wetland), and open water. Large areas of mowed lawn are present in developed areas of the site. Mowed lawn, deciduous forest, and old field are the most common habitat types, each encompassing about 250 acres (100 ha). The dominant species of deciduous forest communities are various species of oak, primarily white oak, bur oak, red oak, and black oak. Coniferous forest totals about 100 acres (40 ha) and consists of planted jack pine, white pine, and red pine stands. Old-field habitats are dominated by non-native grasses and forbs, including many invasive species, with infrequent occurrences of native prairie grass and forb species. Mowed lawns are maintained in the facility areas, Argonne Park area, and roadsides.

The diverse habitats at ANL-E support a high diversity of wildlife species. Common mammal species include striped skunk, coyote, raccoon, opossum, woodchuck, eastern chipmunk, fox squirrel, muskrat, deer mouse, short-tailed shrew, and white-tailed deer. European fallow deer also occur on the site. American toad, western chorus frog, and green frog are common amphibians, while northern water snake, and eastern garter snake are common reptiles. Common bird species include mallard, Canada goose, mourning dove, blue jay, American crow,

American robin, European starling, common grackle, common yellowthroat, song sparrow, and northern cardinal.

Terrestrial habitats in the vicinity of the APS facility, bounded by Rock, Kearney, and Bluff Roads, consist primarily of mowed lawns and other landscaped areas. These vegetated areas are predominantly composed of non-native grass and forb species. A vegetated stormwater collection basin is located southeast of the intersection of Kearney and Rock Roads (Figure 4.2). The basin and much of the surrounding area support a herbaceous vegetation cover and are frequently mowed. A number of native species occur within several small areas of the basin.

Several mature trees (shagbark hickory and bur oak) are located south of Rock Road, adjacent to the stormwater collection basin. A periodically mowed area in the southwest corner of the APS site includes a number of native species commonly found in disturbed areas of the ANL-E site. A 4-acre (2-ha) restored prairie community surrounds a constructed wetland (Wetland R) southeast of the APS facility, across Bluff Road (Figure 4.2). Terrestrial vegetation within the APS ring infield consists primarily of mowed grasses. A small percentage of these grasses consist of native species; however, most of the vegetation within the infield consists of non-native species. The APS infield includes a number of stormwater collection areas consisting of interconnected shallow basins and depressions. Surface runoff collected in the basins in the eastern half of the infield is conveyed to Wetland R by an underground drain line. Some reduction in surface water flow velocities is accomplished by the vegetation cover on the stormwater collection areas.

4.6.2 Wetlands and Aquatic Biota

A survey of wetlands on the ANL-E site was conducted in 1993 (Van Lonkhuyzen and LaGory 1994). Thirty-five wetlands, totaling 44.6 acres (18.1 ha), were identified and delineated. Wetland types on the ANL-E site include marshes, forested wetlands, and scrub-shrub wetlands. Marshes are the most common wetland type and are dominated by cattails, grasses, sedges, and rushes. Many wetlands on the ANL-E site occur along streams. Some wetlands have been formed as a result of human or beaver activities. Several high-quality, relatively undisturbed wetlands occur on the ANL-E site; a number of wetlands, however, are relatively disturbed and generally support degraded plant communities with invasive species and low species diversity. Invasive plant species are especially prevalent in disturbed wetlands and form dense colonies in several areas. Disturbance, pollution, alteration of natural hydrologic regimes, and increased sedimentation generally favor the colonization and spread of invasive species.

Wetland R, a 1.8-acre (0.7-ha) wetland (Figure 4.2), was created southeast of the APS ring to mitigate the losses of two small wetlands during initial construction of the APS facility. Hydrologic sources for this wetland include the adjacent surrounding watershed as well as the stormwater collection system within the eastern half of the APS infield area. Large fluctuations in hydrologic inflow periodically occur in Wetland R following storm events, possibly indicating a high degree of surface water runoff in the infield area. Surface runoff characteristics may be related in part to vegetative cover and a predominance of non-native species. Although

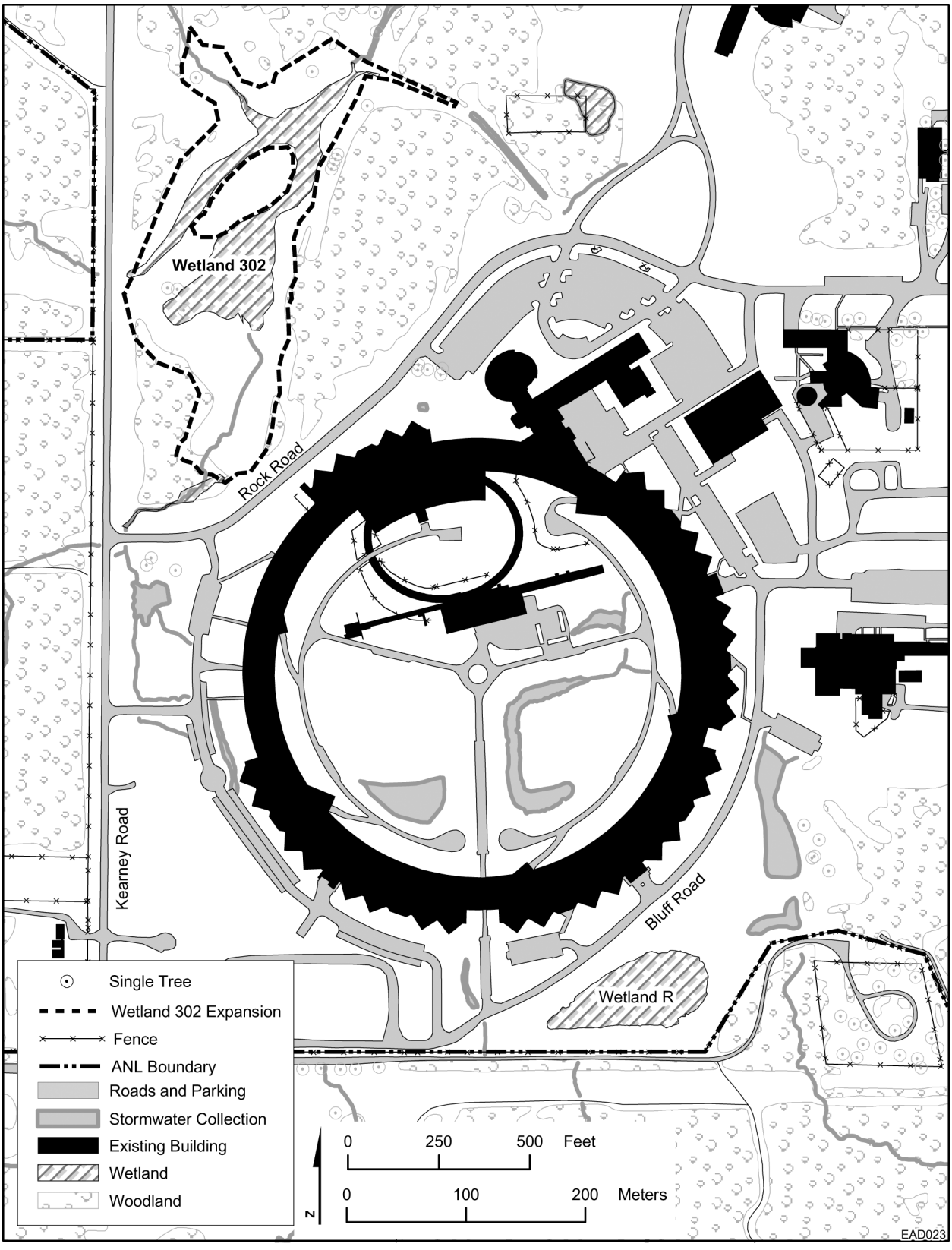

FIGURE 4.2 Wetland Area and Wooded Area at the APS Site

Wetland R supports a high diversity of native wetland species, invasive species are the dominant plant species, forming dense stands in some areas. The predominance of these species has limited the value of this wetland as mitigation. The invasive species include cattail (two species and a hybrid) and river bulrush, which are native species, as well as reed canary grass and common reed, both non-natives. The invasive species are tolerant of poor water quality and altered hydrologic regimes and may indicate a predominance of surface runoff hydrology in the watershed. Wetland management techniques, including the use of herbicides and prescribed burning, have been used to reduce the occurrence of these species in Wetland R.

At the time the APS facility was constructed, a small wetland, identified as Wetland C (DOE 1990), was located approximately 110 ft (34 m) southwest of the facility footprint. This wetland, approximately 1.1 acres (0.45 ha) in size, was shallowly inundated in spring or following heavy rains and was supported primarily by groundwater discharge. The vegetation community of Wetland C was composed entirely of herbaceous species, including many native sedges and forbs. This wetland was avoided during construction of the APS, and any impacts were expected to be temporary (DOE 1990). Following the construction of the APS, the hydrologic regime of Wetland C became drier, with inundation occurring less frequently and for shorter duration, likely due to changes in groundwater flow. This location now lacks wetland hydrology, and the vegetation community is composed primarily of non-native species, including a number of upland species.

A wetland area (Wetland 302) located immediately northwest of the APS facility, across Rock Road, has been restored for compensatory wetland mitigation at the ANL-E site (Figure 4.2). Under the restoration program, Wetland 302 is expected to increase in size from 3.2 acres (1.3 ha) to a potential maximum of 9 acres (4 ha). If the wetland restoration is successful, the increased wetland area will provide compensation for the loss of the former Wetland C and could also provide compensation for potential future wetland impacts on the ANL-E site. Restoration activities included removal of agricultural drain tiles and planting of native species. Surface water inflows to this wetland include the south branch of Freund Brook, an unnamed intermittent stream flowing from the southwest, and a small drainage entering from the northwest. A vegetated stormwater collection area located on the northwest side of the APS facility at the intersection of Kearney and Rock Roads receives surface flow from nearby landscaped areas, parking areas, roads, and roof drains and conveys surface water into the intermittent stream near its entry into the wetland mitigation site.

Wetland 302 restoration goals include an expansion of the wetland area through groundwater recharge and the development of vegetation communities characterized by desirable native plant species. The successful establishment of desired species and the exclusion of invasive species is tied, in part, to watershed characteristics, which include a predominance of native habitats that contribute to a natural hydrologic regime and the high water quality of inflows.

Surface flows from Wetland 302 exit at the northeast and provide the primary inflow to Wetland 303, located immediately downstream. Wetland 303 is approximately 7.5 acres (3.1 ha) in size and consists primarily of marsh communities. The south branch of Freund Brook exits Wetland 302 on the northeast.

The 100-year floodplain of Freund Brook is located northwest of the APS facility (FEMA 1982), across Rock Road and approximately 250 ft (76 m) from the building. The floodplain extends upstream, west of Kearney Road, and downstream to the northeast of Wetland 302.

Aquatic habitats on the ANL-E site include streams (primarily Sawmill Creek and the north and south branches of Freund Brook), ditches, and ponds. Fish species occurring on the ANL-E site include goldfish, creek chub, golden shiner, stoneroller, black bullhead, bluegill, green sunfish, orange-spotted sunfish, largemouth bass, and black crappie. Aquatic invertebrates include larvae of numerous insect species such as blackflies, midges, mosquitoes, caddisflies, and dragonflies, as well as crayfish.

4.6.3 Threatened and Endangered Species

No federally listed threatened or endangered species are known to occur on the ANL-E site (Tuggle 1996); however, several listed species have been reported from the nearby Waterfall Glen Forest Preserve. The Hine's emerald dragonfly (*Somatochlora hineana*), federally listed as endangered, occurs in wetlands associated with calcarious seeps from the dolomite aquifer along the Des Plaines River floodplain, about 3,750 ft (1,000 m) south of ANL-E. Suitable habitat for the dragonfly does not occur at ANL-E (DOE 1990). The leafy prairie clover (*Dalea foliosa*), also federally listed as endangered, is associated with dolomite prairie remnants in the Des Plaines River valley. Two populations of this species have been planted in the Waterfall Glen Forest Preserve. Dolomite prairie habitat does not occur on the ANL-E site. The Indiana bat (*Myotis sodalis*), federally listed as endangered, may occur in the ANL-E region as indicated by an unconfirmed capture in the Waterfall Glen Forest Preserve (DOE 1990). Trees with exfoliating bark may be used by the Indiana bat as summer roosting sites, particularly those in forested areas near open water. A planted population of the lakeside daisy (*Hymenoxys herbacea*), federally listed as threatened, is also located in the Waterfall Glen Forest Preserve. Other federally listed species (bald eagle [*Haliaeetus leucocephalus*], piping plover [*Charadrius melodus*], and least tern [*Sterna antillarum*]) could occur in the ANL-E area as extremely rare nonbreeders during migration or in winter.

Several species listed as threatened or endangered by the State of Illinois occur in DuPage County. The black-crowned night heron (*Nycticorax nycticorax*), state-listed as endangered; Kirtland's snake (*Clonophis kirtlandii*), listed as threatened; pied-billed grebe (*Podilymbus podiceps*), listed as threatened; brown creeper (*Certhia americana*), listed as threatened; and red-shouldered hawk (*Buteo lineatus*), listed as threatened, have all been observed on the ANL-E site. The black-crowned night heron has been observed at many open water areas at ANL-E, while the pied-billed grebe has been observed at Freund Brook. The red-shouldered hawk and brown creeper have been observed in the 600 Area and may utilize most of the wooded areas on-site. Kirtland's snake (*Clonophis kirtlandii*), listed as threatened, may occur on the ANL-E site. The only observation of a Kirtland's snake at ANL-E occurred in 1989, when one individual was found southwest of the APS, west of Kearney Road. No other state-listed species are known to occur at ANL-E, although the river otter (*Lutra canadensis*), listed as threatened; osprey (*Pandion haliaetus*), listed as endangered; shadbush (*Amelanchier interior*), listed as endangered; slender sandwort (*Arenaria patula*), listed as threatened; Tuckerman's

sedge (*Carex tuckermanii*), listed as endangered; Hill's thistle (*Cirsium hillii*), listed as threatened; white lady's slipper (*Cypripedium candidum*), listed as threatened; glade quillwort (*Isoetes butleri*), listed as endangered; and marsh speedwell (*Veronica scutellata*), listed as threatened, occur in the vicinity of the ANL-E site. In addition, the Blanding's turtle (*Emydoidea blandingii*), state-listed as threatened, is known to occur in DuPage County.

No Federal- or state-listed species is known to occur on the APS facility site. Habitats on the site are predominantly disturbed and generally would not provide suitable habitat for listed species. Although wetlands (such as marshy meadows, woodland ponds, and open swamplands) are the preferred habitat for Kirtland's snake, this species may occasionally be found in mowed grassland areas. However, the presence of this species on the APS site would be unlikely because of the availability of abundant preferred habitat elsewhere in the vicinity.

4.7 CULTURAL RESOURCES

Cultural resources include archaeological sites and historic structures and features that are protected under the National Historic Preservation Act (NHPA) of 1966, as amended. Cultural resources also include traditional cultural properties that are important to a community's practices and beliefs and are necessary to maintain the community's cultural identity. Cultural resources that meet the eligibility criteria for listing on the *National Register of Historic Places* (NRHP) are considered "significant" resources and must be taken into consideration during the planning of federal projects. Federal agencies are also required to consider the effects of their actions on sites, areas, and other resources (e.g., plants) that are of religious significance to Native Americans as established under the American Indian Religious Freedom Act. Native American graves and burial grounds are protected by the Native American Graves Protection and Repatriation Act.

4.7.1 Archaeological Resources

The entire ANL-E facility has been surveyed for archaeological resources. The surveys have identified 46 archaeological sites, consisting of both prehistoric sites and historic era farmsteads.

Ten archaeological sites were previously identified in the area occupied by the APS (11Du133, 11Du134, 11Du135, 11Du136, 11Du188, 11Du189, 11Du198, 11Du200, 11Du206, and 11Du209). These sites were mitigated through excavation prior to APS construction (Walitschek et al. 1988). All 10 sites have been completely removed. Three additional sites were previously identified near the APS (11Du190, 11Du201, and 11Du202) (Curtis and Berlin 1980). Sites 11Du190 and 11Du202 are historic sites located west of Kearney Road. Site 11Du201 is a site containing both historic and prehistoric material that is located north of Rock Road and east of Kearney Road.

4.7.2 Traditional Cultural Properties

The land around ANL-E, originally held by the Sauk and Fox Tribes, was ceded to the Potawatami, Ottawa, and Chippewa tribes in 1804. In 1816, a treaty was signed that ceded this land to the United States, including land along the Illinois and Des Plaines Rivers (Alvord 1922:449). The remainder of tribal lands in northern Illinois were ceded in 1836 (Tanner 1987:159).

No known traditional cultural properties have been identified within ANL-E.

4.7.3 Historic Structures

ANL-E was established in 1946 as the first national laboratory. Over the course of more than 50 years, ANL-E has contributed to our knowledge of nuclear science and technology. A sitewide historic building inventory was completed and received State Historic Preservation Officer (SHPO) concurrence in 2001(Wescott and O'Rourke 2001). This inventory evaluated Cold War era structures and facilities at ANL-E for their historical importance. The APS was not evaluated as part of this inventory because it was constructed after 1989, the end of the Cold War. However, several structures near the APS were identified as eligible for listing on the NRHP, such as the Chicago Pile-5 Reactor/Building 330, the Physics and Metallurgy Hot Laboratory/Building 301, and the Building 314/315/316 Complex.

4.8 SOCIOECONOMICS

The ANL-E region of interest, consisting of the area within a 50-mi (80-km) radius of the site, is located in a culturally and economically diverse urban area of more than 8.7 million residents. Neighboring communities include areas that are suburban, commercial, and industrial in character, with businesses in services, manufacturing, transportation, energy, and research and development. Communities are well served by community services, including police and fire, education (preschool through graduate level), and health services. Housing opportunities for low-, middle-, and high-income families exist in the immediate vicinity of ANL-E. Employment centers include the City of Chicago as well as manufacturing, business, and corporate centers in nearby areas.

ANL-E employs about 3,500 full-time equivalents (FTEs). In addition, more than 4,600 visiting researchers use ANL-E research facilities each year. These visitors seek lodging and other services at the commercially operated Argonne Guest House or in the nearby area.

4.9 HUMAN HEALTH

4.9.1 Radiological Environment

TABLE 4.3 Radiation Dose to Latent Cancer Risk Conversion Factors

Receptors	Latent Cancer Risk/ Radiation Dose (1/mrem)
Radiation workers	4×10^{-7} (4 chances in 10 million)
General public	5×10^{-7} (5 chances in 10 million)

Potential radiological effects presented in this section are expressed in terms of mrem for radiation doses, which can be converted to potential latent cancer risks using the dose-to-risk conversion factors listed in Table 4.3. Lifetime cancer risk can be estimated by multiplying cancer risk estimated for one-year exposure by the duration of exposure in years and is interpreted as the probability of contracting a cancer during a lifetime as a result of the radiation exposure. For the general public, the dose-to-risk conversion factor is greater than that for radiation workers because it includes consideration of radiosensitive populations such as infants and young children. According to the National Council on Radiation Protection and Measurements (NCRP 1987), the average dose to a member of the general public in the United States resulting from natural background radiation and medical sources is 360 mrem/yr, which is equivalent to a cancer risk of $1.8 \times 10\text{-}^{4}$/yr. (1.8 chances in 10,000)

At the APS, X-rays are generated by bending the electron beam; X-rays generated in this manner are called synchrotron radiation. The synchrotron radiation X-rays are photons, or packets of light, and represent a potential radiation hazard during APS operations. Lead shielding is used to protect people working near the photon beams from radiation.

The high-energy electrons inside the storage ring cause another type of radiation hazard. When one of these high-energy electrons hits atoms in air, water, or storage ring components, the atom can emit high-energy photons moving in the direction of the electron. When the high-energy photons hit other atoms, they can knock neutrons out of those atoms. These neutrons can be absorbed by neighboring atoms, making the atoms unstable or radioactive. This process is called activation. APS components, air, and water can become activated and remain radioactive for some time after APS operations stop.

Normal Conditions. APS facility operations can expose an individual living or working in its vicinity to external and internal radiation through various pathways. Direct external radiation can be incurred when an individual is close to activated APS components or to APS beamlines. Exposure to external and internal radiation can occur when an individual is exposed to and inhales air activation products released by the APS. Potential receptors discussed in this section include APS workers (that is workers having access to most areas of the APS), beamline users (scientists using the APS and having access to experimental areas), on-site workers (other workers at the ANL-E site), and the off-site public.

According to Moe (1991), at the closest approach location, 1.3 m (4.3 ft) from the APS storage ring, the external dose rate was estimated to be about 0.05 mrem/h. Assuming an APS worker (the maximally exposed individual, MEI) spends 2,000 h/yr working at this location, the

radiation dose he receives would be 100 mrem/yr, which is a small fraction of the dose limit of 5,000 mrem/yr set to protect radiation workers (10 CFR 835).

Beamline users would be exposed to radiation in the module experimental areas. The external radiation dose in module experimental areas was conservatively estimated to be 5.8 mrem/yr (Moe 1991) for the MEI of the beamline users, assuming an exposure duration of 2,000 h/yr at a distance of 20 m (66 ft) from the storage ring. In reality, no positive exposure was found among the APS workers and beamline users in 2000 and 2001, according to the dosimetry data (Dolecek 2002). A total of about 1,800 dosimetry badges were issued each year.

At the nearest site boundary, assumed to be 140 m (459 ft) from the electron orbit, the annual external radiation dose was estimated to be 6.25 mrem/yr (2 mrem/yr from direct radiation and 4.25 mrem/yr from skyshine) for an 8,000-hour operation (Moe 1991). Therefore, for an on-site worker within the same distance from the electron orbit, the maximum external radiation dose would be 1.56 mrem/yr, assuming an exposure duration of 2,000 hours per year and no shielding protection. According to the environmental monitoring data for penetrating gamma radiation in 2001 (Golchert and Kolzow 2002), the average background level in the local area was about 103 (± 20) mrem/yr; radiation levels measured at two locations at the ANL-E fence line about 350 m from the electron orbit were 122 (± 23) mrem/yr and 116 (± 16) mrem/yr. In 2000 (Golchert et al. 2001), the average background level was measured to be 99 (± 20) mrem/yr; levels measured at the two fence line locations were 101 (± 4) and 102 (± 6) mrem/yr. Radiation levels at these two fence line locations were impacted not only by APS operations but also by the operations of other ANL-E facilities. Measurements at these two fence line locations are not statistically different from the background level. Therefore, potential external radiation exposures received by the off-site public from the APS operations are expected to be small.

The APS operations can cause air activation inside the accelerator shielding enclosure, resulting in airborne emission of radionuclides. Primary airborne activation products are C-11, N-13, and O-15, of which N-13 makes up about 90% of the radionuclide emissions. The concentrations of these radionuclides are below the detection limit of the APS stack monitor. It is estimated that a total of 7.38 Ci (0.1 Ci of C-11, 6.56 Ci of N-13, and 0.72 Ci of O-15) (Golchert and Kolzow 2002) were released from the APS facility in 2001. Using these estimates and CAP88-PC (a U.S. Environmental Protection Agency [EPA] air dispersion model), the maximum radiation dose to a hypothetical individual living at the fence line (south-southeast 1,312 ft [400 m] from the emission stack) was estimated to be 0.0043 mrem/yr; the radiation dose to the nearest off-site resident (west-southwest 2,625 ft [800 m] from the emission stack) was 3.2×10^{-4} mrem/yr (Golchert and Kolzow 2002). These estimated radiation doses are extremely small compared with the radiation dose limit of 10 mrem/yr set for airborne emissions (Title 40, Part 61, of the *Code of Federal Regulations* [40 CFR 61]). In the same year, a total of about 1,466 Ci of radionuclides were released by the entire ANL-E operations. Assuming the CP-5 reactor is the central emission point for the ANL-E site and radiation doses estimated by CAP88-PC for each individual release were combined, then the highest perimeter dose would be 0.38 mrem/yr in the east direction (Golchert and Kolzow 2002). The maximum perimeter dose resulting from the APS operations was 0.11 % of that from the entire ANL-E operations.

Short-lived activation products (primarily O-15) can be produced in the water circulated in a closed system to cool the accelerator component of the APS; however, the production rate in water was estimated to be at least an order of magnitude lower than that in air (Swanson 1979). The blowdown water was discharged to the on-site wastewater system, which was discharged off-site after treatment. Oxygen-15, the primary activation product in the cooling water, has a very short half-life (2 minutes) and would decay before entering the treatment system. Therefore, potential radiation exposures resulting from the discharge of O-15 in the cooling water are not possible. Other activation products in the cooling water generated by the APS operations are C-11, tritium (H-3), N-13, and beryllium-7 (Be-7). However, according to the estimates made by Moe (1991), the production rates of these isotopes ($<4 \times 10^{-5}$ Ci) are small fractions of the production rate of O-15, and the resulting on-site and off-site doses are insignificant.

Table 4.4 summarizes the potential radiation exposures of various receptors from APS operations. The radiation exposures are all well below the dose limit of 100 mrem/yr set to protect the general public from the DOE operation, or 5,000 mrem/yr set to protect radiation workers (10 CFR 835).

Off-Normal Conditions. Radiation exposures greater than those discussed under normal conditions would occur if the electron beam is lost during the APS operations. However, the chance for such an accident to occur is extremely small because of the implementation of the Access Control and Interlock System (ACIS), an engineering safety system for integrating access control and monitoring devices for the accelerator systems. The ACIS provides protection by ensuring that no one can occupy or enter an area where accelerator beam radiation may be

TABLE 4.4 Maximum Radiation Doses to Various Receptors from the APS Operations

		Dose to Individual (mrem/yr)	
Receptor	Radiation Source	Estimated	Measured
APS workers	Direct external radiation	100	No positive result
Beamline users	Direct external radiation	5.8	No positive result
On-site workers	Direct external radiation	1.6	NA[c]
Off-site general public[a]	Direct external radiation	< 6.5	Within background level
	Airborne emission	0.0043	NA[c]
	Waterborne emission	~ 0	NA[c]
Member of public or worker	Natural background radiation and medical sources	360[b]	NA[c]

a The MEI of the off-site public was assumed to reside at the fence line that would yield the largest dose. An average person would receive a radiation dose much less than the MEI dose.

b Average dose to a member of the U.S. population as estimated in Report No. 93 of the National Council on Radiation Protection and Measurements (NCRP 1987).

c Not available.

present. It is designed to turn off the source of radiation when there is a possibility of someone being exposed. Furthermore, the potential consequences of beam losses were taken into consideration in radiation shielding design, and local shielding was added to the accelerator components where analyses showed significant radiation exposures could occur.

Among the scenarios analyzed involving beam losses at various APS components, the maximum credible incident (MCI) is based upon a scenario in which the electron beam is lost at the highest elevation in the rising section of the LEUTL line going from the synchrotron to the mezzanine directly above the region of the beam loss (see Figure 4.3 for the location of the

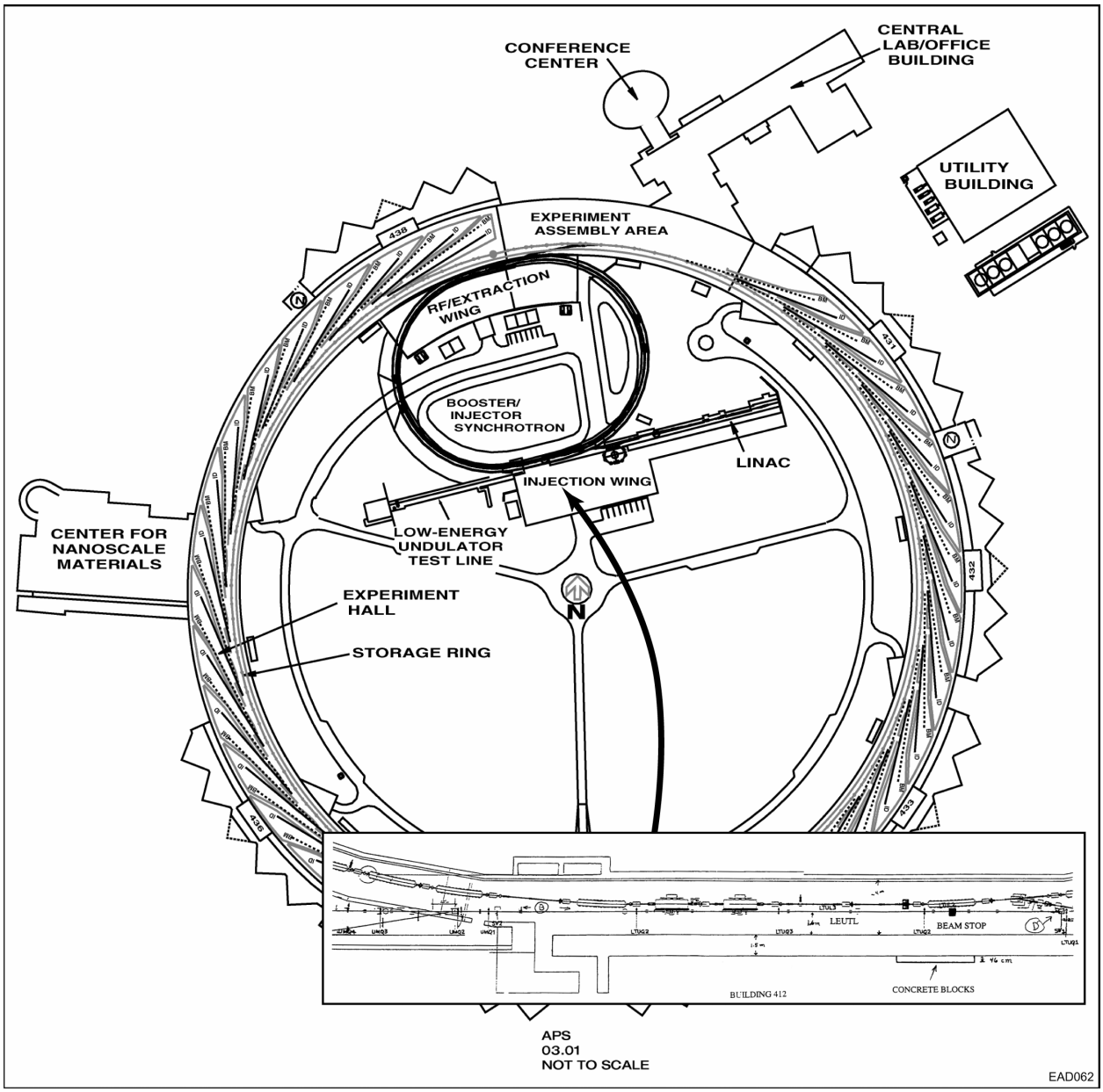

FIGURE 4.3 Location of the Maximum Credible Incident

incident) (Moe 1998). According to the analysis for the MCI, in which an APS worker was assumed to stand at a distance of 7.9 ft (2.4 m) from the loss point through the 3-ft (1-m) concrete floor of the mezzanine, the estimated dose rate is 13.1 rem/h. At the concrete floor of the mezzanine, a neutron-gamma radiation monitor is located that is interlocked to the beam. When the radiation level at the mezzanine, close to the loss point, exceeds the set level (10 mrem/h for photons and 3 mrem/h for neutrons), the operation would be turned off, and the beam would trip in just a few microseconds. Assuming this condition persists as long as a minute, the total dose received by the APS worker closest to the loss point would be 218 mrem. At a distance of 460 ft (140 m), the dose to an on-site worker would be about 0.066 mrem. The dose to an off-site individual would be less than 0.066 mrem because of a greater exposure distance. Realistically, the radiation exposures would be much smaller than the estimated values because the incident would last much shorter than one minute. On the basis of the calculation results, it is concluded that no significant on-site or off-site impact is expected from a radiation incident at the APS.

4.9.2 Nonradiological Environment

Nonradiological contaminants resulting from APS operations come from experimental sources that may include trace amounts of organic solvents, toxic proteins, microbiological products, compounds containing heavy metals, and small amounts of carcinogens. ANL-E uses thousands of chemicals in conducting research in physical, biomedical, chemical, materials, and environmental sciences. These chemicals are tracked from purchase to disposal through the ANL-E Chemical Management System (CMS). The CMS process facilitates compliance with environmental, safety, and health requirements. Reports generated through the CMS identify chemicals that are toxic (including carcinogens) and provide data for completing ANL-E's Toxic Release Inventory (TRI) and Superfund Amendments and Reauthorization Act (SARA) Title III reports.

Nonradiological hazardous contaminants generated at ANL-E, including those generated at APS, are managed in accordance with the ANL-E Plant and Facilities Services (PFS) Waste Management Operations (WMO) Operating Procedures Manual (see Section 4.10.) Nonradiological biological or medical contaminants are managed in accordance with the ANL-E Environment, Safety, and Health (ESH) Manual. Policies contained in that manual require adequate control of exposure potentials (through either engineering or administrative controls, or both) before experimental activities are allowed to commence. Consequently, no potential human exposure to nonradiological hazardous or biological contaminants is expected to occur from APS operations.

A minute amount of nonradiological contaminants is released to laboratory sinks at the APS during rinsing and cleaning activities and is discharged to the ANL-E wastewater treatment plants where it is combined with wastewater from other ANL-E facilities. The wastewater is treated, processed, and discharged to Sawmill Creek through the ANL-E National Pollutant Discharge Elimination System (NPDES) Outfall 001. Wastewater discharges are sampled and analyzed according to requirements in the NPDES permit. In 2001, no exceedance of the regulatory limits for 5-day biological oxygen demand (BOD_5), mercury, and chemical oxygen

demand (COD) occurred, and very small amounts of a few contaminants in concentrations similar to those in treated drinking water were found to be present (Golchert and Kolzow 2002). Because the nonradiological contaminants from APS operations constitute a small fraction of ANL-E wastewater contaminants that are received and treated to NPDES permit limitations before discharge, human exposure to APS contaminants is not expected to occur.

4.10 WASTE MANAGEMENT

Research and maintenance activities at the APS result in the generation of small volumes of a variety of wastes. Hazardous wastes generated at the APS are collected in specified waste containers, documented, packaged according to ANL-E waste handling procedures, and initially accumulated at or near the point of generation. Hazardous wastes are then picked up by trained ANL-E WMO personnel. Table 4.5 compares the typical annual volumes of wastes by category that are generated at the APS to the volumes of those waste categories generated by all ANL-E operations. All hazardous waste generated at ANL-E (including universal waste [see Table 4.5]) is delivered by licensed carriers to properly permitted commercial treatment or disposal facilities. All low-level radioactive waste (LLW) generated at ANL-E is delivered by licensed carriers to DOE's disposal facility in Richland, Washington. Other types of waste generated at ANL-E that are not generated at the APS, such as transuranic waste, are not addressed in this EA.

ANL-E holds an Illinois Environmental Protection Agency (IEPA) Resource Conservation and Recovery Act (RCRA) Part B Permit (IL0438020002) that allows ANL-E to manage hazardous waste at several designated container storage areas, one tank storage unit, and several treatment units before the waste is shipped off-site to properly RCRA-permitted treatment, storage, and disposal facilities.

General refuse (nonhazardous solid waste) is discarded to dumpsters staged at ANL-E buildings. To avoid improper disposal of chemical or hazardous wastes, procedures have been established to guide ANL-E personnel on what wastes can be placed in dumpsters. Wastes placed in dumpsters are collected by a commercial waste hauler and transported to the hauler's processing facility where recyclable materials are removed. The remaining waste is transported for disposal to an IEPA-permitted sanitary landfill. Construction and demolition waste is managed in roll-off containers which, when full, are transported by commercial haulers to processing facilities where recyclable materials are removed. Remaining materials are delivered to an IEPA-permitted landfill for disposal.

Wastewater is generated by a number of activities at the APS and consists of sanitary wastewater (from restrooms, cafeteria sinks and sinks in certain buildings and laboratories), laboratory wastewater (from laboratory sinks and floor drains in most buildings), de-ionized and purified water for laboratories and accelerator component cooling, and stormwater. Cooling water and cooling tower blowdown waters are discharged into the ANL-E laboratory wastewater treatment system.

TABLE 4.5 Hazardous and Radiological Waste Generated Annually by ANL-E and the APS[a]

Waste Category	ANL-E Quantity (gal)	APS Quantity[b] (gal)
RCRA hazardous waste[c]	10,048[d]	511[e]
HSWA universal hazardous waste[f]	13,672[d]	40[e]
Low-level radioactive waste[g]	31,933[h]	5[e]
Wastewater	321.2 million	56.8 million

[a] Both solid and liquid wastes were generated. For RCRA reporting, all waste totals are converted to gallons.

[b] Quantities represent wastes resulting from operations at the following APS divisions: Accelerator Systems Division (ASD), Experimental Facilities Division (XFD), APS User Program Division (UPD), and APS. Wastes related to infrastructure maintenance at BioCARS are also represented in these totals. Pursuant to APS policy, wastes resulting from experiments by external collaborators are returned to the home institutions of those collaborators. The data represent wastes delivered to WMO over the period September 1, 2001, through August 30, 2002.

[c] RCRA hazardous wastes are defined in 40 CFR 261. Illinois Environmental Protection Agency (IEPA) definitions are equivalent to the federal definitions.

[d] ANL-E Site Environmental Report, 2001, Section 2.3; see Table 2.7 for hazardous waste generated, treated, disposed of, or recycled in calendar year 2001; see Table 2.8 for mixed waste generated, treated, stored, and disposed of in calendar year 2001 (Golchert and Kolzow 2002).

[e] Data derived from WMO operating data (McNamee 2003a).

[f] Hazardous and Solid Waste Amendments of 1984 (HSWA) universal wastes include such items as spent fluorescent bulbs, some pesticides, spent lead acid batteries, and instruments and equipment containing elemental mercury. Universal wastes are defined in 40 CFR 273; IEPA definitions are equivalent to the federal definitions.

[g] Low-level radioactive waste (LLW) is defined by the U.S. Nuclear Regulatory Commission (NRC) regulation as radioactive waste that (1) is not high-level radioactive waste, spent nuclear fuel, transuranic waste (TRUW), or by-product material as defined in Section 11(e)(2) of the Atomic Energy Act (AEA) of 1954, and (2) is classified by the NRC as LLW.

[h] Data provided by WMO (McNamee 2003b).

Wastewater is treated at the APS in two independent treatment systems, the sanitary system and the laboratory system. The sanitary wastewater collection and treatment system collects wastewater from sanitation facilities, the cafeteria, office buildings, and other portions of the site that do not contain radioactive or hazardous materials. This wastewater is treated in a biological wastewater treatment system consisting of primary clarifiers, trickling filters, final clarifiers, and slow sand filters.

Wastewater discharge at ANL-E is permitted by NPDES Permit No. IL 0034592. Under the provisions of this permit, treated sanitary wastewater is combined with treated laboratory wastewater and discharged through Outfall 001 to Sawmill Creek. The permit also addresses 39 other discharge points for industrial wastewaters (including, e.g., cooling water and cooling tower blowdown water) and stormwater that can be discharged without treatment but are required to be monitored by ANL-E. These additional discharge points hydraulically communicate with Sawmill Creek or with the Des Plaines River. The permit was renewed in 1994 (effective date, October 30, 1994), was modified in 1995 (effective date August 24, 1995), and was scheduled to expire on July 1, 1999. An application to renew the existing permit was submitted to the IEPA on December 28, 1998, allowing ANL-E to continue to operate under the provisions of the existing permit until the IEPA issues a replacement permit. A proposed renewal permit was issued for public comment in December 2002 and is expected to be issued in 2003. The volumes of wastewaters discharged at ANL-E in 2001 were 1.4 million L/day (0.38 million gal/day) of sanitary wastewater and 1.9 million L/day (0.50 million gal/day) of laboratory process wastewater.

The BSL-2 experiments at the APS generate small amounts of biological waste, less than 1 kg per year at the current usage of the facility. This waste is disinfected and then disposed of according to established ANL-E protocols.

A list of waste management permits issued to ANL-E is provided in Appendix C.

4.11 TRANSPORTATION

The ANL-E area is served by air, rail, and highway transportation systems. In addition, bulk materials are shipped near the ANL-E site along the Ship and Sanitary Canal between the Illinois River and Lake Michigan.

Visitors to the APS site arrive by car. ANL-E is normally accessed on the east by Northgate Road from Cass Avenue and on the west by Westgate Road from Lemont Road. Both access roads are two-lane, hard-surface roadways. Cass Avenue and Lemont Road both have full interchanges with Interstate 55, the Stevenson Expressway, less than one mile north of the site. Traffic entering or leaving ANL-E by Westgate Road is controlled by a traffic light, while traffic leaving ANL-E by either Northgate Road or Eastgate Road is controlled by stop signs. Access to the APS site within ANL-E is by two-lane, hard-surface road on the north, east, and west sides of the site, and the facility is surrounded by a hard-surface access road with parking lots at even intervals around the ring.

4.12 UTILITIES AND SERVICES

Electrical service to ANL-E is provided by Exelon, formerly known as Commonwealth Edison. ANL-E is a member of the ComEd (Exelon) energy cooperative, which is a voluntary agreement to curtail energy use during periods of peak energy demand. APS currently consumes approximately 25 MW of power per year, which is equal to the annual power consumption of approximately 225,000 residential customers. Since the 1990 APS EA was published, purchase of Lake Michigan source water from the DuPage County Water Commission has been implemented as an alternative to reliance upon on-site wells and canal water. ANL-E also has an on-site Central Heating Plant, a boiler facility for producing heat and steam for the site.

4.13 ENVIRONMENTAL JUSTICE

On February 11, 1994, the President of the United States issued Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority and Low-Income Populations." This Executive Order mandates that Federal agencies incorporate environmental justice considerations as part of their missions. It directs federal agencies to address, as appropriate, disproportionately high and adverse human health or environmental effects of their actions, programs, or policies on minority and low-income populations. The Executive Order's accompanying cover memo specifically mentions the NEPA, providing the opportunity to incorporate environmental justice as part of the NEPA process.

Approximately 8.7 million people live within census tracts located within a 50-mi (80-km) radius of ANL-E, and approximately 183,000 people live within census tracts located within 5 mi (8 km) of ANL-E (Table 4.6). On the basis of 2000 census data, 51% of the 50-mi (80-km) population and 24.5% of the 5-mi (8-km) population are comprised of minorities, as compared with the state averages of 32.2% for Illinois, 14.2% for Indiana, and a national average of 30.9% (Figure 4.4). On the basis of 1990 census data (2000 data are not yet available), 10.7% of the 50-mi (80-km) population and 2.4% of the 5-mi (8-km) population are low-income, as compared with the Illinois average of 11.3%, the Indiana average of 9.9%, and the national average of 13.3 % (Figure 4.5). Table 4.6 summarizes the distribution of minority and low-income populations in the area surrounding ANL-E.

TABLE 4.6 Summary of the Distribution of Minority and Low-Income Populations Surrounding ANL-E

Radial Distance around ANL-E	50-mi	5-mi
Population and Minority Population Statistics (2000)[a]		
Total population	8,691,957	183,256
Minority population	4,252,327	41,861
Native Americans or Alaska Natives	23,026	259
African Americans	1,686,284	10,427
Hispanic origin	1,462,388	12,277
Asians or Pacific Islanders and other race categories	1,080,629	18,898
Percent of minority populations	51%	24.5%
Low-Income Population Statistics (1990)[a]		
Total population	7,839,245	171,691
Population below poverty line	835,673	4,098
Percent low-income populations	10.7%	2.4%

[a] Based on information available for whole census tracts that fall within 50-mi and a 5-mi radii of the center of the APS facility at ANL-E; income data are not yet available for the 2000 census.

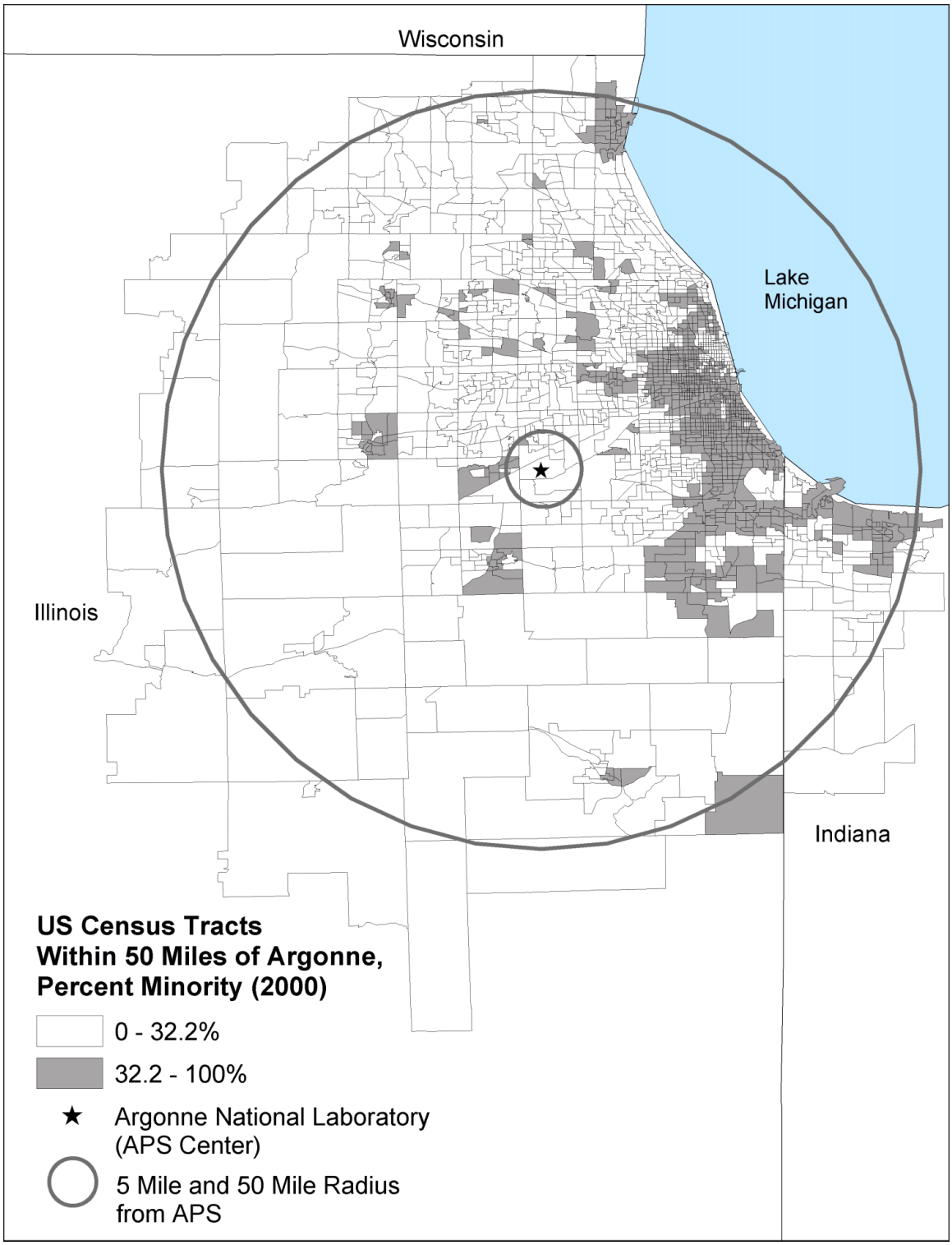

FIGURE 4.4 Minority Composition of Populations within 5 and 50 Miles of ANL-E, Based on 2000 U.S. Census Data

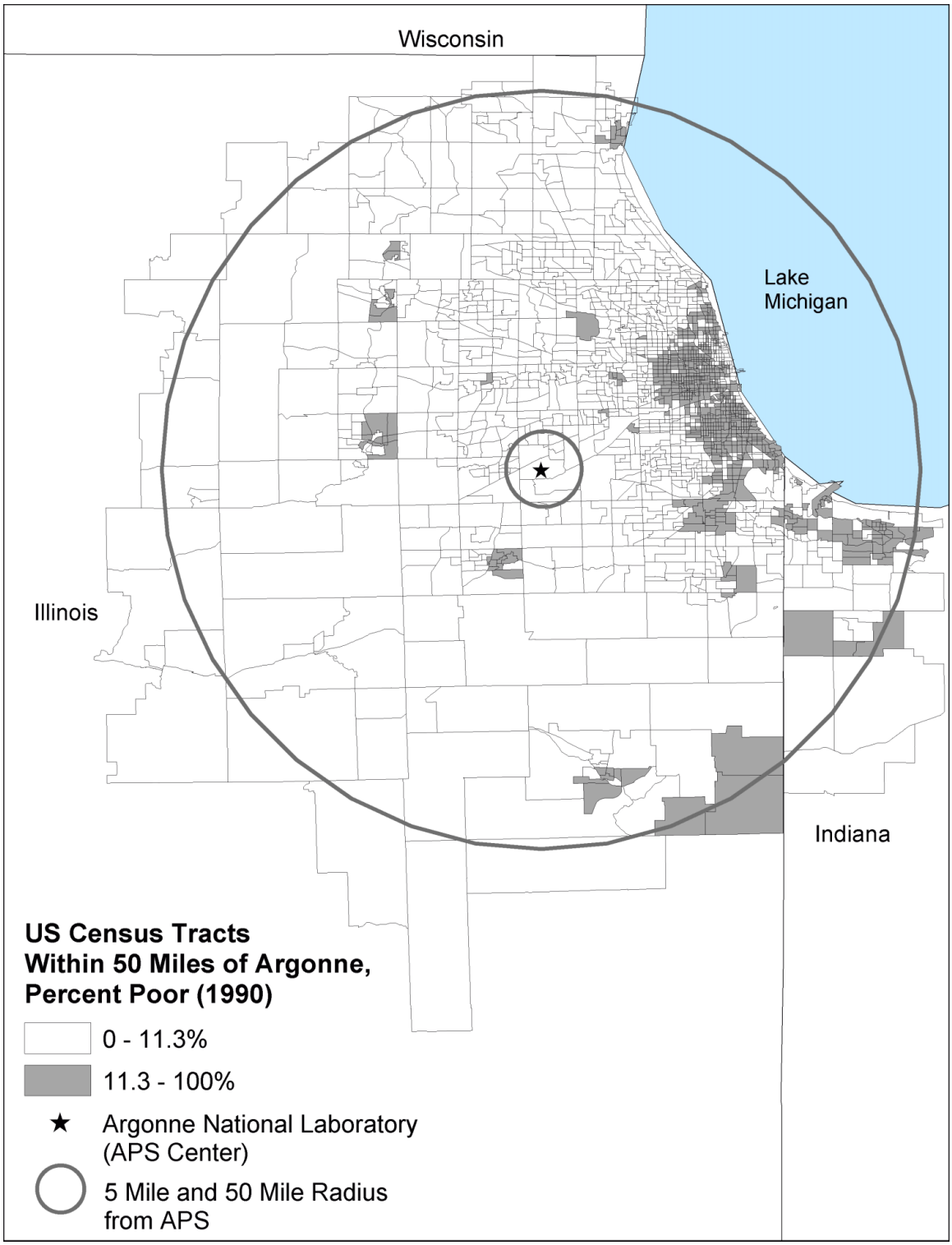

FIGURE 4.5 Income Composition of Populations within 5 and 50 Miles of ANL-E, Based on 1990 U.S. Census Data